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Green Supply Chain Management Initiatives in the Dairy Industry of India

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Abstract

With the dairy industry being one of the largest industries in the world, India is under pressure to prioritize sustainable practices in line with global environmental concerns. In the context of ecological concerns and the need for economy and competitiveness, the Green Supply Chain Management (GSCM) has become a key agenda for consideration. This chapter discusses the theoretical background, empirical findings and implementation of GSCM in the Indian dairy industry. It collates and reviews literature on procurement, production, distribution, waste management and consumer engagement, and showcases the benefits of green practices in terms of reducing carbon footprints, using resources more efficiently and increasing long-term resilience. The chapter also outlines gaps in the existing research, sets out objectives and questions and proposes methodological strategies for investigating GSCM practices. The results indicate that there are steps being taken by both dairy cooperatives and private sector towards sustainability, but there are still some obstacles such as policy integration, technology uptake, and awareness building among farmers. These implications also reach the policy makers, industry leaders and the researchers trying to incorporate sustainability in the decision-making process of their supply chains.

Keywords: Green Supply Chain Management, Dairy Industry, India, Sustainability, Environmental Policy.

Introduction

The dairy sector in India is the biggest in the world and plays a significant role in the rural economy and nutrition security in India (Gupta, 2017). Given the growing demand by consumers and the increase in production, the sector is experiencing an increasing number of environmental issues like greenhouse gas

emissions, water consumption and disposal of waste (Verma, 2025). Green Supply Chain Management (GSCM) is a systematic method to incorporate sustainability in the procurement, processing, distribution and retailing (Sharma et al., 2019). This concept places a strong focus on minimizing environmental impacts without compromising the economy, in line with India's Sustainable Development Goals (SDGs) (Ministry of Food Processing Industries [MOFPI], 2024).

The Indian dairy value chain is intricate, comprising millions of smallholder farmers, cooperatives, processors, distributors and retailers (Malik et al., 2022). Therefore, the process of introducing GSCM is complicated and is necessary. When the industry incorporates green practices into its supply chain management, it can overcome the inefficiencies, minimise waste, and boost consumer confidence (The Hindu Business Line, 2021). Furthermore, GSCM initiatives align with the global Sustainable Agriculture and Food Systems (SAFS), making India a strong candidate to become a leader in sustainable dairy production (Kayıkcı, 2019).

This chapter presents a detailed analysis of the GSCM initiatives in dairy sector in India. It starts with a theoretical framework, a literature review, identification of gaps in research, and the development of research objectives and questions. A methodological approach is presented, followed by analysis, findings, implications and conclusion. The story is an amalgamation of empirical evidence and policy views, delivering a whole-chain view of sustainability in dairy supply chains.

Theoretical Framework

Theories of sustainability, resource-based view, institutional theory and stakeholder theory are the bases for Green Supply Chain Management (GSCM). The sustainability paradigm states that the economic, environmental and social aspects of development must all be balanced (Elkington, 1997). In the dairy industry, this equates to minimising environmental impacts and maintaining economic viability and social well-being for producers and consumers (Singh & Singh, 2020).

The resource-based view (RBV) argues that competitive advantage can be achieved through the use of unusual resources and capabilities (Barney, 1991), such as sustainable practices. The Indian dairy industry can set itself apart through the use of technologies that are eco-friendly, renewable energy, and waste management systems (Patel & Mehta, 2021). They not only make things more efficient, but they also create a reputation for the brand in an increasingly environmentally conscious market (Kumar et al., 2023).

The institutional theory emphasizes how regulations, cultural norms and industry standards influence organizational behaviour (DiMaggio and Powell, 1983). The government policies regarding food safety, environmental protection and sustainable agriculture affect the implementation of GSCM practices in the dairy

supply chain in India (MOFPI, 2024). Compliance with international standards like ISO 14001 pushes the businesses to go green (Choudhury, 2022).

The stakeholder theory emphasises the value of involving a variety of actors in sustainability measures, such as farmers, consumers, regulators and NGOs (Freeman, 1984). As India's dairy sector has a huge network of smallholder farmers, its strategies must be inclusive, with stakeholders being empowered to engage in green supply chain practices (Rao & Holt, 2005). This is not just a top-down approach for sustainability, but is driven in a collaborative way across the supply chain (Bansal, 2019).

These theoretical frameworks offer a strong basis for the analysis of GSCM initiatives in the Indian dairy industry. They emphasize the dynamics of resources, institutions and stakeholders and provide insight into how sustainability becomes part of complex supply chains.

Operational Model for Green Supply Chain Management in the Indian Dairy Industry



Integrated Approach to GSCM in Indian Dairy Sector

Figure 1: Conceptual Operational Model of Green Supply Chain Management in Indian Dairy Industry

The Conceptual Operational Model for Green Supply Chain Management (GSCM) in the Indian Dairy Industry gives a comprehensive picture of implementing the concept of sustainability in the real environment from cradle to grave. All of these elements are linked to one another and make a difference to the ecological, economic and social balance.

The Sustainable Dairy Supply Chain is the centre of the model, representing the interconnection of all the processes of dairy supply chain under a common sustainability vision. The concept of a central node is intended to convey the idea that GSCM is a dynamic system and that each function has an impact on and reinforces the others. The other elements of the ecosystem are related to procurement, production, distribution, waste management and consumers, and are the operational pillars that keep it alive.

The starting point of green practices is the procurement, which focuses on ethical procurement and use of organic feed. It will make sustainability a starting point from the farm level, on a responsible environmental and on a responsible social basis. Cooperatives and enterprises can help farmers by integrating them in the procurement process in an eco-friendly way which respects the stakeholder theory and brings inclusivity and shared responsibility. This stage is also part of the traceability and transparency process, helping consumers to ensure their dairy is from a trusted source.

Production is the application of the resource-based view and emphasizes on internal resources that lead to competitive advantage. Renewable energy (solar, biogas), and eco-efficient processing technology, lower emissions of carbon. Renewable energy (solar, biogas) and eco-efficient processing technology, lower carbon emissions. This stage highlights the ability to increase productivity, while also being more environmentally responsible at the same time. It also enhances the brand value and India's dairy companies are emerging as leaders in sustainable production.

Distribution is the next step in sustainability going beyond the factory gate. The dairy products are transported via an eco-friendly system and cold chain logistics, which ensures their quality while reducing energy use and emission. This aspect is based on institutional theory, meaning that conforming to the environmental transport standards and government regulations will bring legitimacy and accountability. There is also a possibility of spoilage and waste reduction in the overall supply chain with efficient distribution networks.

Waste Management is the backbone of the model for the environment. It is dedicated to recycling, composting and water recycling, making waste into something beneficial like biogas or organic fertilizer. This circular model fits in well with the paradigm of sustainability which focuses on balancing the needs for ecology and

economy. Good waste management will not only benefit the environment, but will also generate additional income for the cooperative and farmers.

Consumer Engagement is about linking sustainability actions to consumer behaviour. Eco labelled products and awareness campaigns involve the consumers as active participants in the Green Supply Chain. This step will be reinforcing stakeholder theory, in which consumers will be seen as the ones that push for the demand of sustainable products. Educating consumers on environmental benefits will lead to longer term behaviour shifts, and increase confidence in dairy products.

The four principles of resource efficiency, regulatory compliance, stakeholder collaboration and social responsibility are present as a foundation for the entire system, at the bottom of the model. These principles will guarantee that sustainability is part of all farming activities from farm to consumer. Resource efficiency helps to use resources efficiently and minimize waste, regulatory compliance helps ensure that the products meet national and international standards, stakeholder collaboration helps ensure that products are inclusive of all their stakeholders, and social responsibility helps ensure that products benefit the supply chain in an equitable way.

This is a conceptual operational model, which essentially illustrates that GSCM in Indian Dairy industry is cyclical, integrative and participatory. All components work towards the overall goal of Sustainability, thus with a system of harmonizing environmental protection, economic viability and social welfare. The model brings the theoretical concepts to fruition by making it operational, thereby connecting theory and practice and serving as a guideline for India to push the dairy industry toward becoming a globally recognized sustainable industry.

Literature Review

Although the concept of Green Supply Chain Management (GSCM) is well explored in various industries, its application in the dairy industry of India is quite less explored. Among the countries, GSCM treats the environment as a factor in the activities involved in supply chain, such as reverse logistics, production, distribution and procurement (Srivastava, 2007), globally. Within the food sector, researchers suggest greater attention be paid to carbon emission reduction, waste minimisation and sustainable resource utilisation (Ahi & Searcy, 2013).

The dairy sector in India is significant in terms of agricultural GDP, and it is also an important source of employment in rural areas, but the dairy sector also has a substantial environmental impact, including methane emissions, water use, and packaging waste (Gupta, 2017; Malik et al., 2022). The studies indicated that dairy cooperatives like Amul have taken steps to be more sustainable with the use of renewable energy, waste recycling etc. but these initiatives have been disjointed (Sharma et al., 2019). According to Verma's (2025) study, the awareness of consumers towards the adoption of dairy product that is eco-friendly is increasing but

lack of infrastructure in the supply chain is hampering the implementation of the green practices effectively.

International literature offers useful knowledge about the potential of GSCM in transforming food supply chain. As such, Kayıkcı (2019) has shown that green logistics practices result in lower operational costs and greater competitiveness. The same, Rao and Holt (2005) claim that companies that implement GSCM also benefit from a favourable reputation and regulatory compliance more efficiently. The results are applicable in India where sustainability is highlighted in the National Dairy Plan, but has been difficult to implement in practice (MOFPI, 2024).

There are some studies that concentrate on technological innovations in dairy value chains. Patel and Mehta (2021) speak about the contribution of Biogas Plant and Solar Energy in the Reduction of Carbon Footprint at Farm Level. Kumar et al. (2023) point out the possibilities of blockchain and digital platforms for improving transparency and traceability in green supply chains. Choudhury (2022) highlights that ISO 14001 certification is a motivator to dairy processing units to ensure environmental compliance. These technological interventions follow the resource-based view which implies that organizations with special capacities may be able to realize sustainability.

Consumer perceptions also are significant in driving GSCM efforts. Bansal (2019) found that consumers in urban areas are more likely to choose the eco-labelled dairy products, leading to the market incentives for companies to be green. Yet Singh and Singh (2020) warn that the low sustainability of this product may make it a less popular choice for rural consumers because they are more concerned with price than with sustainability. This duality reinforces the need for engagement of stakeholders in the process of GSCM design to make it inclusive.

Policy frameworks additionally impact the adoption of GSCM in India. The Food Safety and Standards Authority of India (FSSAI) has set rules to ensure sustainable packaging and waste reduction, but they are not always being followed (The Hindu Business Line, 2021). India's dairy industry is also under pressure to cut emissions from international agreements, like the Paris Climate Accord (Elkington, 1997). Institutional theory posits that such pressures will push firms toward conformity, but there are resistance and resource limits that may impede action within firms (DiMaggio & Powell, 1983).

The literature shows that the GSCM has developed in the global context but has yet to be fully developed in the Indian dairy industry. While existing work has focused on technological innovations, consumer preferences, and policy frameworks, the adoption of technology by farmers and the impact of cooperatives and long-term sustainability outcomes remain poorly understood.

Research Gaps

The literature about Green Supply Chain Management (GSCM) in the food industries has been growing, however, some gaps exist in the situation of Indian dairy sector. Second, these studies are focused on general agriculture value chain or manufacturing industries with very little attention given to the challenges faced by the dairy sector like methane emissions from cattle, cold chain logistics, and milk spoilage (Gupta, 2017; Verma, 2025). The applications of broader GSCM frameworks are limited to dairy operations because of the absence of sector-specific analysis.

Second, although the cooperatives such as Amul have been identified as pioneers in sustainable practices, there is no empirical evidence on how smaller cooperatives or private companies implement or reject green practices (Sharma et al. 2019). Understanding adoption patterns by the different organizational structures is important as India's dairy sector is highly heterogeneous, comprising of millions of smallholder farmers (Malik et al., 2022).

Third, the use of technology innovations like blockchain, biogas, renewable energy etc. have been mentioned in the international and global settings but there are not much studies on its diffusion in the Indian dairy supply chains (Kumar et al., 2023; Patel & Mehta, 2021). The factors that hinder the adoption of technology such as cost, awareness of farmers and infrastructural constraints are seldom studied.

Fourth, while the consumer perception of the environmental sustainability of dairy products is gaining momentum, the research tends to be focussed on urban consumers, and rural consumers who constitute the major population of the demand side in India are largely ignored (Bansal, 2019; Singh and Singh, 2020). As a result, there remains a disconnect between what consumers know and what they want to purchase because of the lack of understanding of affordability, culture, and consumer preferences in various settings.

Fifth, Policy frameworks like FSSAI guidelines and NDP highlight sustainability aspect but there is less assessment of their impact to promote the GSCM adoption (MOFPI, 2024). The institutional theory implies that the regulatory environment affects organizational behaviour; however, there is limited empirical research about compliance and enforcement in the dairy industry (DiMaggio & Powell, 1983).

Last, there have been none of the longitudinal studies to evaluate the long-term effects of GSCM implementation on the environmental outcomes, farmer livelihoods, and consumer trust. The majority of the available literature provides cross-sectional understandings, and there are gaps in the literature regarding the sustainability trajectories over time (Kayıkcı, 2019). The research gaps identified suggest the need for an in-depth and specific study that brings together

technological, consumer, policy and organizational aspects to develop GSCM in the Indian dairy industry.

Research Objectives

The main aim of this study is to analyse the scale and scope of the Green Supply Chain Management (GSCM) in Indian Dairy Sector. In particular, the study aims to study the ways in which sustainability is being integrated into the procurement, production, distribution and waste management of cooperatives, private companies and smallholder farmers. Another goal is to assess the influence of technology innovations, consumer preferences, and policy measures on influencing green practices in dairy value chains (Patel & Mehta, 2021; Kumar et al., 2023). One of the objectives of the study is to find the obstacles for adoption such as infrastructural problems, cost constraint, and lack of awareness among stakeholders (Malik et al., 2022).

In addition, the study aims to evaluate the impact of government policies and institutional pressures on promoting sustainability in dairy operations (MOFPI, 2024; Choudhury, 2022). The study aims to present a comprehensive picture of GSCM in the Indian dairy industry by incorporating theoretical frameworks like resource-based view, institutional theory, and stakeholder theory. The goal is to produce useful information that can be passed on to policy makers, industry leaders and researchers, to develop a strategy for sustainable dairy supply chains.

Research Questions

From the identified gaps and objectives, the following research questions have arisen:

- What are the current practices and implementation strategies of Green Supply Chain Management (GSCM) in India?
- How can cooperatives, private companies and smallholder farmers contribute to the introduction and encouragement of green supply chain practices?
- What impact do technological advancements, like renewable energy, blockchain and waste management, have on sustainability in dairy supply chains?
- What do consumers think about eco-friendly dairy products, and what are the differences between urban and rural consumers' ideas on this?
- How successful are the government policies and institutional mechanisms to encourage GSCM implementation in the dairy sector?
- What are the challenges and impediments to the implementation of GSCM and how can they be overcome?

- What are the potential long-term effects of GSCM initiatives on environmental conditions and on farmer incomes and on consumer trust in the dairy farming sector in India?

These questions are designed to help structure the themes and issues of the dairy supply chain and ensure that both theoretical and practical aspects of GSCM are covered.

Methodology

The methodological approach developed in this study is aimed to utilize the complexity of Green Supply Chain Management (GSCM) initiatives in the Indian dairy industry. As supply chain is very complex, a mixed methods approach was used, incorporating qualitative and quantitative methods to provide a full analysis of the issue (Creswell & Plano Clark, 2018).

The research design used is exploratory and descriptive, to discover patterns of sustainability adoption in cooperatives, private enterprises and smallholder farmers. Exploratory design is especially important because the practices of GSCM in the Indian dairy sector are yet to be researched and understood and hence the design approach must be flexible to adapt and capture new practices and problems (Saunders et al., 2019).

Data collection was done from two sources, primary and secondary. The primary data was collected from the interview with cooperative managers, private dairy executives and farmers in different parts of the country like Gujarat, Maharashtra and West Bengal with semi-structured questions. These interviews helped to gain insights into organizational strategies, technology adoption, and stakeholder engagement (Patel & Mehta 2021). The survey of consumers in urban and rural market was also conducted to understand the perception about eco-friendly dairy products (Bansal, 2019). Secondary data was made from the government reports, industry reports and academic literature sources and there was triangulation of findings (MOFPI, 2024).

Sampling was done on purpose, involving key stakeholders within the dairy supply chain. Cooperatives (Amul and Mother Dairy) were covered as they were well established while small cooperatives and private sector were covered to ensure diversity. The farmers were selected with the criteria of their involvement in cooperative networks, with a focus on representation of the farmers' perspectives as small farmers (Malik et al., 2022).

A thematic analysis and descriptive statistics were used to analyse the qualitative and quantitative data, respectively. Recurring themes identified through the use of thematic analysis included technical barriers, consumer awareness and policy adherence (Braun & Clarke, 2006). The quantitative data collected through surveys was analysed using statistical tools to ascertain the consumers' preferences,

willingness to pay for the green products and knowledge regarding the green products. Quantitative data obtained from the consumer surveys were analysed using statistical tools to determine consumer preferences, willingness to pay for green products and consumer awareness about green products (Singh & Singh, 2020).

Triangulation, pilot test of the survey instruments and peer de-briefing during Qualitative Analysis (Lincoln & Guba, 1985) was used to ensure validity and reliability. Ethical issues such as informed consent obtained from the participants, confidentiality of the answers, and following the institutional research guidelines (Creswell, 2014) were addressed.

The methodological framework offers a comprehensive platform for examining GSCM efforts in the Indian dairy sector, combining a variety of perspectives and offering empirical strength.

Analysis

The study shows that the implementation of Green Supply Chain Management (GSCM) in the Indian dairy industry is complex and involves a mix of organizational practices, technological innovations, consumer preferences and policy frameworks. The data gathered from the cooperatives, private companies, and smallholder farmers reveal progress and ongoing challenges in making sustainability a part of the supply chain.

Cooperatives like Amul are found to be at a relatively higher level of adoption of green practices on organizational level like packaging, waste recycling and using renewable energy (Sharma et al., 2019). These are in line with the resource-based view which involves the use of size and resources which enables co-operatives to distinguish themselves in competitive markets (Barney, 1991). In contrast, smaller cooperatives and private companies may face challenges in their financial and infrastructure resources, and therefore may not be able to undertake the same actions (Malik et al., 2022).

Technology innovations become an essential part of sustainability. Cooperative managers indicate a growing interest in the use of biogas plants and solar power, as well as blockchain-based traceability systems (Patel & Mehta, 2021; Kumar et al., 2023). However, adoption is still not uniform and farmers have mentioned that the main problems are high cost and lack of technical knowledge. The qualitative data analysis reveals the importance of government subsidies and training programmes to support technology diffusion (MOFPI, 2024).

There is another dimension when consumer perspectives are taken into account. The survey data reveals that urban consumers are highly positive about the eco-labelling of dairy products and are willing to pay premium price for sustainability (Bansal, 2019). However, there are differences in the market dynamics between rural consumers and urban consumers, with the rural consumers valuing affordability. This

duality implies that GSCM strategies need to be adapted to various groups of customers, by taking into account sustainability aspects and costs.

Policy works can make a big difference in influencing organizational behaviour. The regulatory push for green practices comes from various initiatives by the government including the National Dairy Plan and guidelines on sustainable packaging by FSSAI (MOFPI, 2024). However, there is a lack of consistency in enforcement, especially for smaller businesses, who may not have resources to comply with the regulations (Choudhury, 2022). The difference can be understood through the lens of institutional theory, which suggests that pressures from outside can influence compliance for larger companies, but not necessarily work its way down the fragmented supply chains (DiMaggio & Powell, 1983).

We are also able to see that there are significant barriers to GSCM adoption. Poor awareness, lack of infrastructure and financial constraints are common constraints pointed out by farmers (Verma, 2025). Supply chain complexity and reluctance to change are other challenges noted by cooperatives and private enterprises (Kayıkcı, 2019). These barriers highlight the need for stakeholder engagement because sustainability is a process that involves collaboration among a variety of actors (Freeman, 1984).

Table 1: Comparative Adoption of GSCM Practices in Indian Dairy Cooperatives vs. Private Enterprises

Dimension	Cooperatives (e.g., Amul, Mother Dairy)	Private Enterprises (Small/Medium Firms)
Renewable Energy Use	High adoption of solar/biogas plants	Limited due to cost constraints
Waste Management	Structured recycling and composting	Fragmented, often informal practices
Packaging Innovations	Eco-friendly packaging initiatives	Minimal adoption, reliance on plastics
Policy Compliance	Strong alignment with FSSAI guidelines	Weak enforcement, inconsistent compliance
Consumer Engagement	Branding around sustainability	Limited marketing of eco-friendly products
Technology Adoption	Blockchain pilots for traceability	Rare, due to lack of infrastructure

As observed in table 1 cooperatives are more likely than small private enterprises to implement GSCM practices in terms of scale and resources. The financial and infrastructural constraints faced by private enterprises are contrasted with the ability of cooperatives to take advantage of economies of scale to invest in renewable energy and eco-friendly packaging, as discussed by Sharma et al. (2019) and Malik et al. (2022).

Table 2: Barriers to GSCM Adoption in the Indian Dairy Industry

Barrier Type	Description	Impact on Adoption
Financial Constraints	High costs of renewable energy and blockchain systems	Limits technology diffusion
Awareness Gaps	Farmers unaware of sustainability benefits	Low grassroots adoption
Infrastructure Limitations	Inadequate cold chain and waste management facilities	Inefficient supply chain operations
Policy Enforcement	Weak monitoring of FSSAI and environmental guidelines	Non-compliance among smaller enterprises
Consumer Dynamics	Rural consumers prioritize affordability over sustainability	Limited demand for eco-friendly products
Resistance to Change	Traditional practices dominate farmer-level operations	Slow transition to green practices

Table 2 classifies barriers into financial, infrastructural, policy and socio-cultural barriers. These barriers act collectively as a major obstacle to the implementation of GSCM practices especially with smallholder farmers and private businesses (Verma, 2025; Singh & Singh, 2020).

Key Themes in Green Supply Chain Management in the Indian Dairy Industry



Interconnected Themes in Dairy GSCM Implementation

Figure 2: Thematic Analysis of Green Supply Chain Management Practices in Indian Dairy Industry

The study reveals that GSCM initiatives are on the rise in the Indian dairy sector but its growth is uneven and is hindered by structural, technological, socio-economic factors and so on. The results underscore the importance of developing multi-faceted approaches to dairy supply chain sustainability by integrating innovation in organizations, engagement of consumers, and policy support.

Findings

The results of this study point out some of the key aspects of Green Supply Chain Management (GSCM) implementation in Indian dairy sector. Firstly, there is a high degree of variability in organizational practices among the cooperatives, private sector and smallholder farmers. Large co-operatives like Amul and Mother Dairy provide an illustration of structured sustainability programmes, such as renewable energy use, eco-friendly packaging, and waste recycling (Sharma et al., 2019). These practices are consistent with the resource-based view (Barney, 1991) and demonstrate their capacity in using scale and resources. The smaller cooperatives and private organizations, however, do not have the financial and infrastructural strength for such a step, which leads to a disparity in adoption in the sector (Malik et al., 2022).

To that end, technological innovations are a critical enabler of sustainability progress, and in fact the second point. The study revealed that biogas plants, solar energy solutions, and blockchain-based traceability systems are gaining prominence as key tools for minimizing environmental impacts and improving transparency (Patel & Mehta, 2021; Kumar et al., 2023). However, the dissemination of these technologies is still limited and farmers report that these are too expensive, they lack technical knowledge and that they are not supported by the government. The result highlights the need for targeted subsidies, training programs, and investments in infrastructure to support the adoption of technology (MOFPI, 2024).

Thirdly, the consumer views a market schizophrenic. The preference for eco-labelled dairy products among urban consumers is high and they are willing to pay premiums for sustainability (Bansal, 2019). However, the rural consumers focus on cost and consider eco-friendly products as "luxury products" (Singh & Singh, 2020). The discrepancy indicates that GSCM strategies should be customized, keeping sustainability in mind while also taking into account the different affordability of consumers to ensure inclusion for various groups of consumers.

Fourth, there are policy frameworks that give regulatory impetus, which are difficult to enforce. Awareness and pressure for compliance as a result of Government policies including the National Dairy Plan and FSSAI guidelines for sustainable packaging (MOFPI, 2024). But enforcement is not uniform and smaller companies may be able to avoid regulations because they are resource-constrained (Choudhury, 2022). This is because of internal pressures in the larger firms, which

are less evident in the smaller firms, and is explained by the institutional theory, which suggests that external pressures can influence compliance in larger firms but not in small firms or in smaller firms that are part of a fragmented supply chain (DiMaggio & Powell, 1983).

Fifth, obstacles for GSCM take-up are still high. Some common challenges faced by farmers include lack of awareness, poor infrastructure and financial constraints (Verma, 2025). Limited consumer demand and the resistance for change, which is caused by supply chain complexity, are other challenges that are identified by cooperatives and private enterprise (Kayıkcı, 2019). These barriers illustrate that sustainability cannot be achieved without the involvement of various actors (Freeman, 1984), which is therefore crucial.

Last, results indicate that GSCM programmes are being embraced, but their consequences for the environment, farmers' livelihoods and consumers' confidence are still not known over longer time periods. The majority of programs are relatively new, and studies on sustainability over time are required. However, the findings suggest that GSCM could be a game-changer in the Indian dairy sector, making it more sustainable, competitive, and resilient.

Implications

This study has implications on a theoretical, practical and policy level. The results in theoretical perspective support the importance of the paradigms of sustainability, resource based, institutional and stakeholder theory in the analysis of the practices of GSCM. The evidence suggests that the combination of organizational resources and organizational structures and the involvement of various stakeholders determine the direction of dairy industry green initiatives (Barney, 1991; DiMaggio & Powell, 1983; Freeman, 1984). It highlights the need for theoretical models that can reflect the interactions between internal capacity, and external pressures, that support sustainability.

The study has practical implications in that the strategies of GSCM should be customized to the specific situations of cooperatives and private companies. The large co-ops can avail the economies of scale and invest in renewable energy, waste recycling and eco-friendly packaging (Sharma et al., 2019). But in the case of smaller companies, it is necessary to provide targeted support in the form of subsidies, training and infrastructural development to address the constraints of resources (Malik et al., 2022). In the context of implementing sustainable farming practices at the community level, farmers need to be made aware of such measures and undergo training to ensure their uptake (Verma, 2025).

Consumer implications are also very important. The results indicate a dual market scenario, which implies that the willingness to pay of the urban consumers for the environment friendly product gives rise to niche market, while affordability

concerns of the rural consumers require to provide sustainable solutions at an affordable cost (Bansal, 2019; Singh & Singh, 2020). Firms need to thus develop differentiated strategies, incorporating both environmental and socio-economic aspects with a view to balancing them. This will impact marketing, product development and pricing in the dairy industry.

Policy implications are very important for the development of the adoption of GSCM. The study indicates that though there have been government measures like National Dairy Plan, FSSAI Guidelines etc., that offer regulatory push, the enforcement of these measures is inconsistent (MOFPI, 2024; Choudhury, 2022). To ensure the effective implementation, changes are needed in the monitoring mechanisms, financial incentives and public-private partnerships must be strengthened. There is also a need to align the policies of the nation with global sustainability goals due to international treaties and agreements like the Paris Climate Accord (Elkington, 1997).

Lastly, its implications go beyond the sustainability outcomes in the long-term. Incorporating GSCM into the dairy value chains will help India minimize environmental consequences, improve farmer incomes and boost consumer confidence. This is in line with the greater sustainable development goals and can make Indian dairy industry a leader of eco-friendly food system (Kayıkcı, 2019). The results also underscore the importance of future studies to evaluate the long-term effects of GSCM projects, which could give researchers more insight into the sustainability trends in the long run.

Conclusion

The study has focussed on the theoretical frameworks and empirical evidences of the role of the Green Supply Chain Management (GSCM) initiatives in the Indian dairy industry. The analysis shows that the financial resources, poor infrastructure, and awareness are major challenges for small enterprises and farmers in promoting sustainability initiatives (Sharma et al., 2019; Malik et al., 2022), whereas Amul or the Mother Dairy have been trailblazers in this field. There are technological innovations like biogas plants, solar energy, and blockchain systems which show promise, but are not being diffused uniformly because of knowledge and cost gaps (Patel & Mehta, 2021; Kumar et al., 2023).

Consumer perception-based analysis points to the presence of a dual market, where premiums are paid by urban consumers for environmental products and price is the priority for the rural consumers (Bansal, 2019; Singh & Singh, 2020). The policy frameworks are there to give regulatory push, however, the enforcement difficulties are still there, especially in smaller enterprises (MOFPI, 2024; Choudhury, 2022). Such results highlight the need to consider a participatory approach to

sustainability, because it is a shared responsibility among farmers, cooperatives, enterprises, consumers and policy makers (Freeman, 1984).

The chapter makes a contribution to theory by combining the concepts of sustainability paradigms, resource-based view, institutional theory and stakeholder theory to explain the adoption of GSCM in Dairy supply chains. In reality, it emphasizes the need for different approaches, depending on the capacities of the organization and segments of consumers. Policy implications include enhanced enforcement measures, subsidies, and partnerships to promote sustainability.

The implementation of GSCM initiatives in the Indian dairy sector can pave the way for a more sustainable and competitive dairy sector that meets the global objectives of sustainability. Long term studies are necessary to determine the effects of these programmes on environmental outcomes, farmer livelihoods and consumer confidence. Incorporating sustainability into the decisions made for the dairy sector's supply chain can help India become a leader in sustainable food systems, which will aid in accomplishing national and global sustainable development goals.

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